IS SOIL COMPACTION FROM ANIMAL TRAFFIC A PROBLEM IN PASTURES

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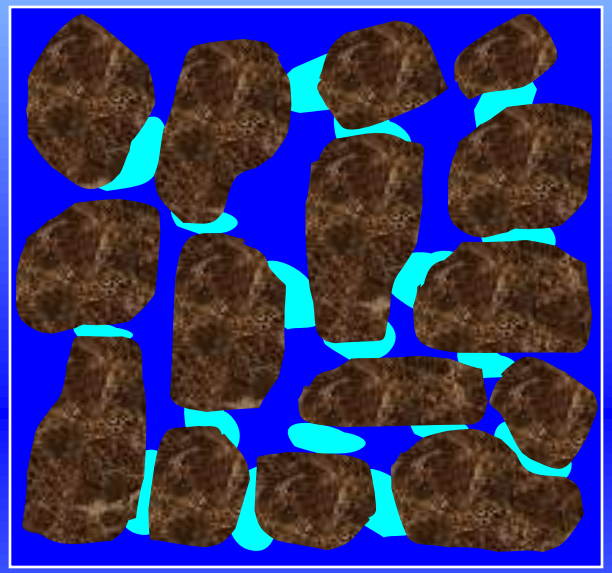
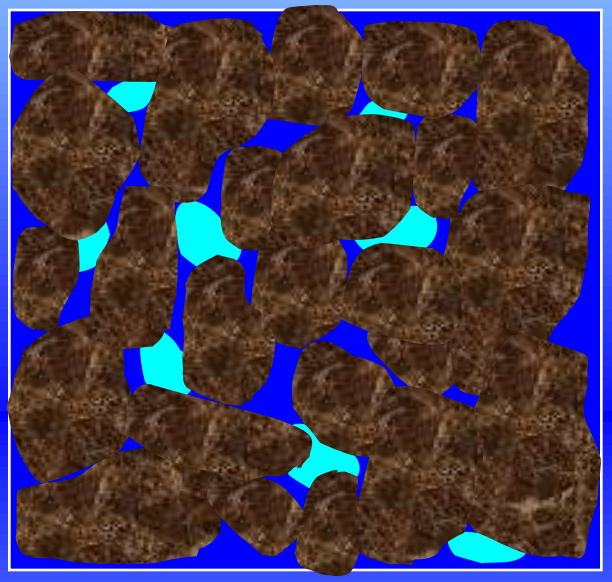
SOIL COMPACTION DEFINED

Compression of the soil from an applied force that first re-arranges and then destroys aggregates increasing bulk density and reducing porosity

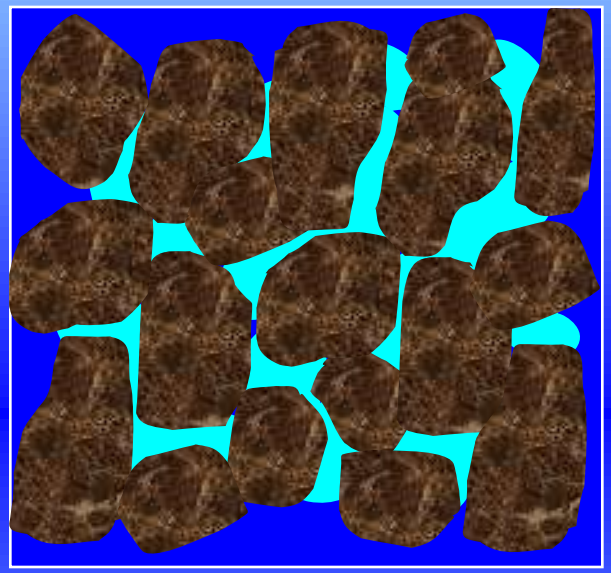
- Wheel traffic from field operations
- Tillage
- Livestock



B.D. = 1.0

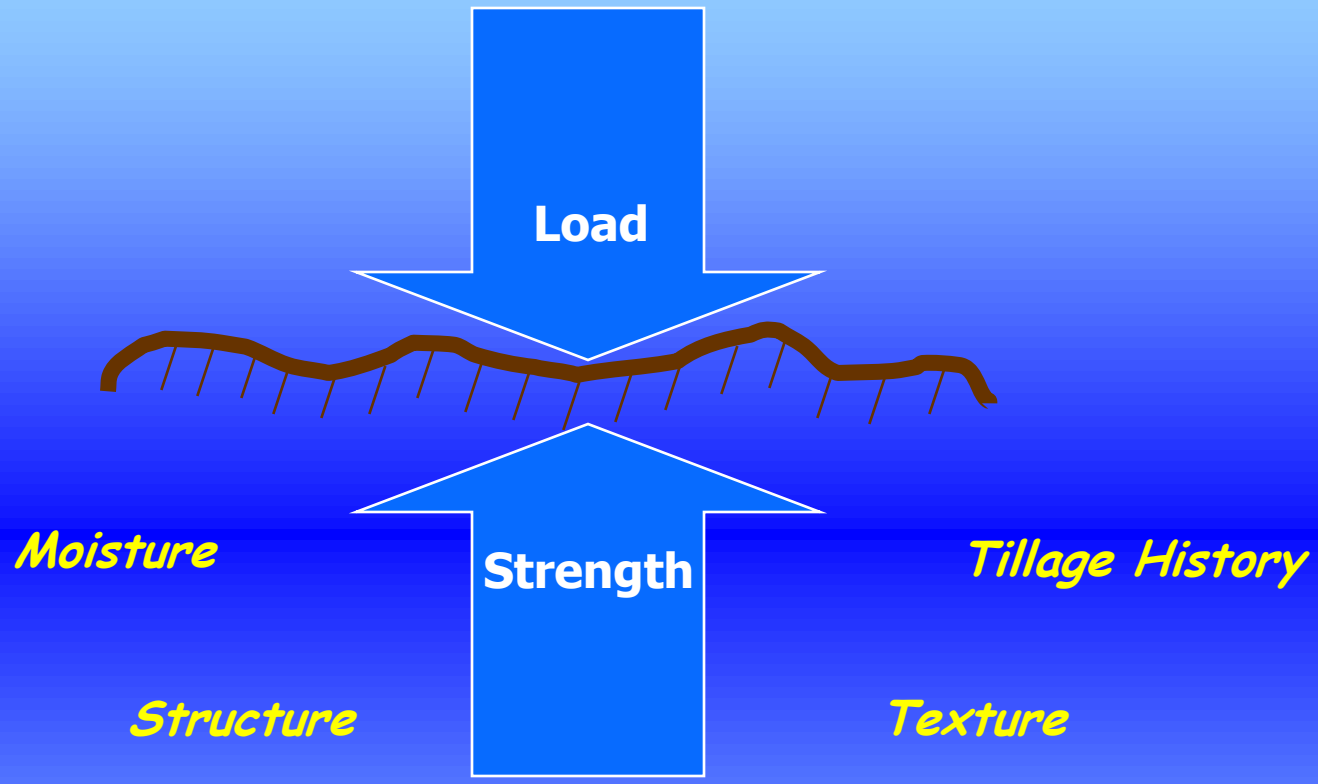


B.D. = 1.3



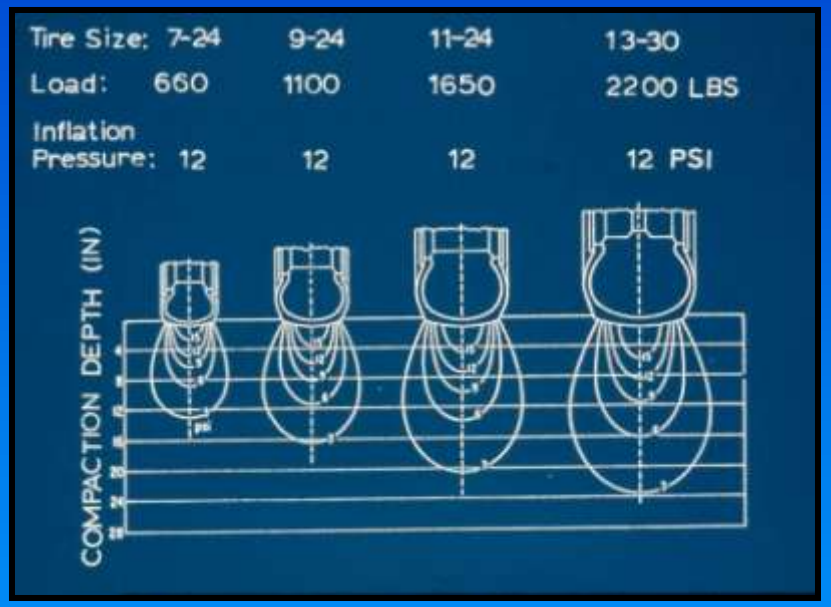
B.D. = 1.6

COMPACTION IS A PROCESS



Soil compacts when load-bearing strength of soil is less than load being applied.

WHICH IS WORSE – PRESSURE OR LOAD?



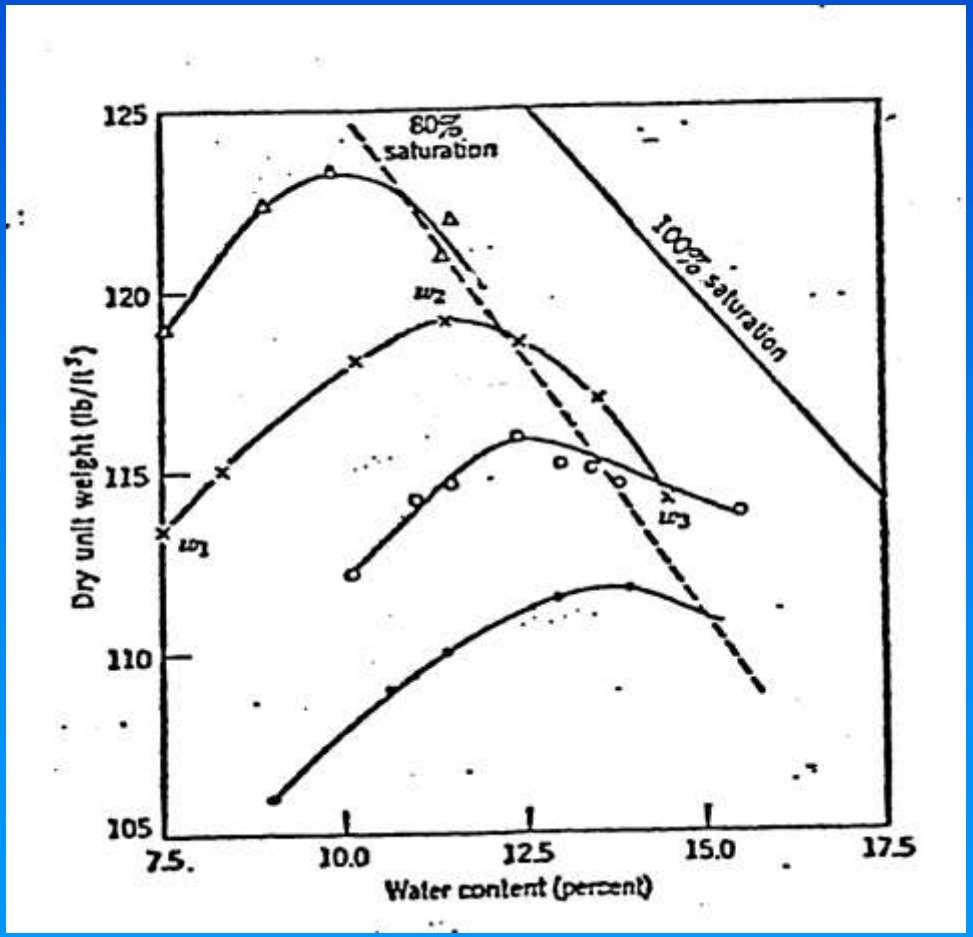
High PSI, but small load

Low PSI, but large load

THE LARGER THE LOAD THE DEEPER THE COMPACTION EFFECT

"COMPACTABILITY" INFLUENCED BY WATER CONTENT

- VARIES BY SOIL
- MAXIMUM NEAR FIELD CAPACITY
- DRY SOIL HAS MORE STRENGTH
- SATURATED SOIL NOT COMPACTABLE



WHEEL-TRAFFIC COMPACTION IS AN ISSUE

- Larger equipment
- Earlier field operations
- Loss of forage in rotation
- Operations on wet soils
- Time management
- Uncontrolled traffic
- Brain cramps

QUANTIFYING COMPACTION

- Crop and Soil Symptoms
- Penetration Resistance
  - *Moisture Dependent*
  - *No Absolute Value*
  - *Note Depth and Relative Force*
  - *Compare Good and Bad Areas*
- Bulk Density
  - *Mass per Volume*
  - *Inversely Related to Porosity*
  - *Texture Dependent*


"Cloddy" soil following corn silage harvest


Stunted, uneven growth is often
the first symptom

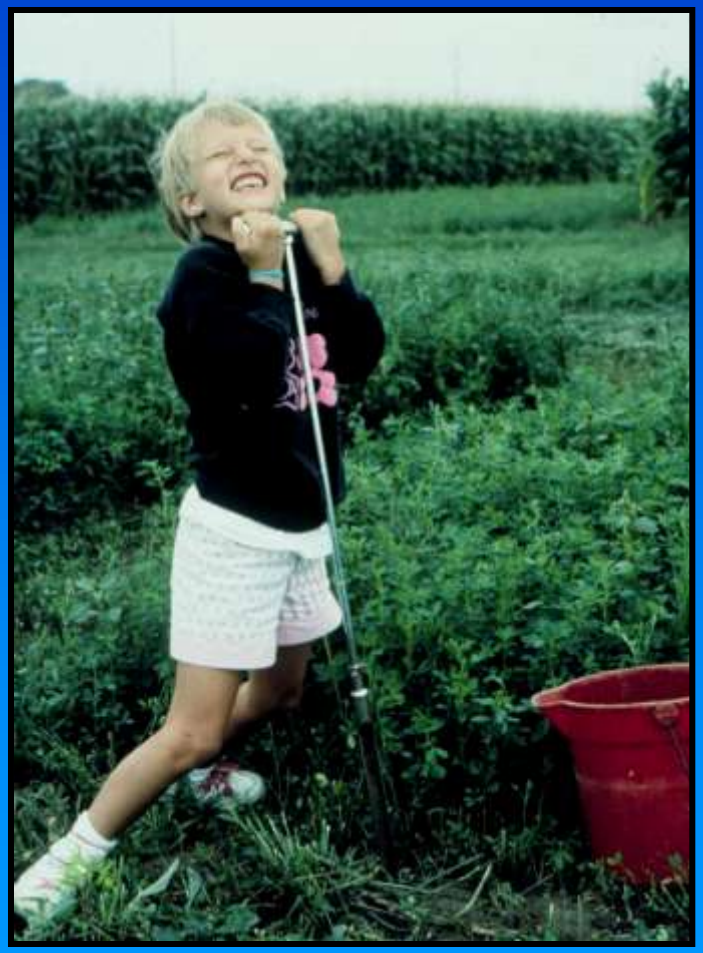

"Pancake"
root mass


Many pastures are converted cropland and may have a plow layer


The shovel is an excellent diagnostic tool

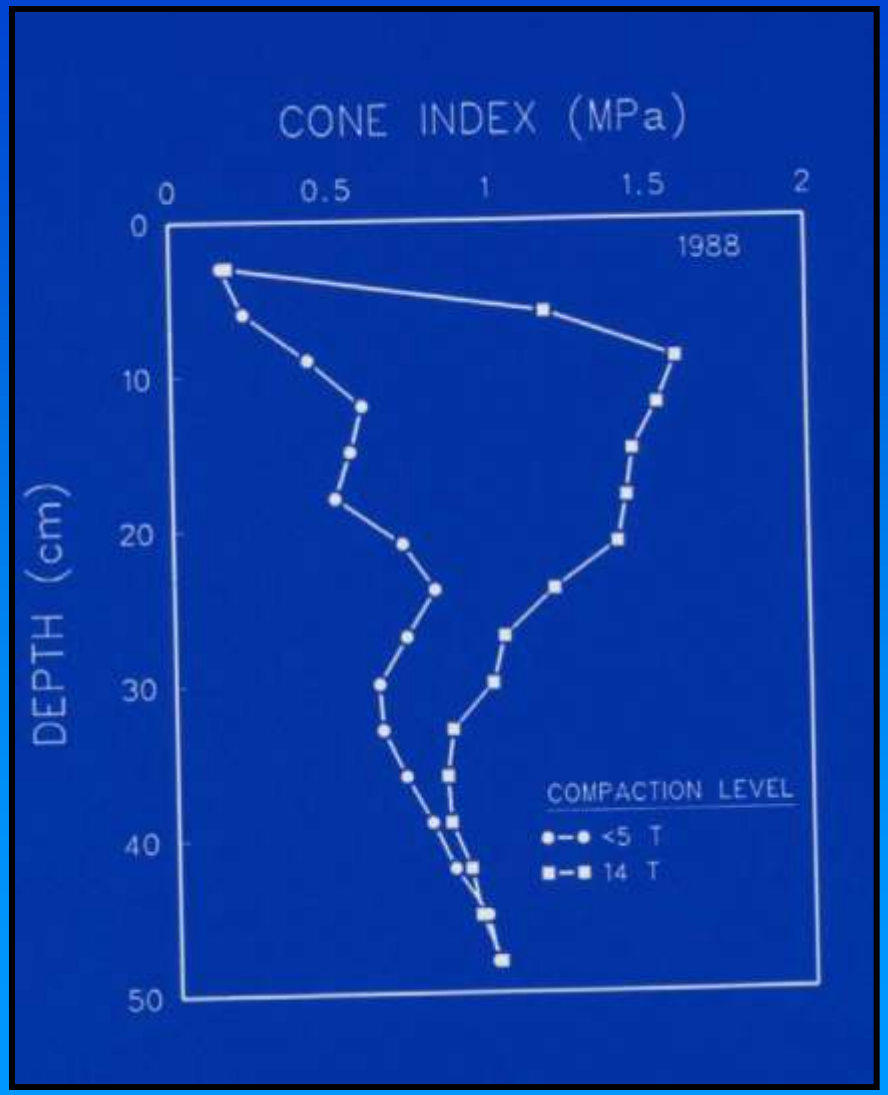
MEASURING PENETRATION RESISTANCE

Hand-held penetrometer



Soil probe

CONSTANT-RATE RECORDING PENETROMETER



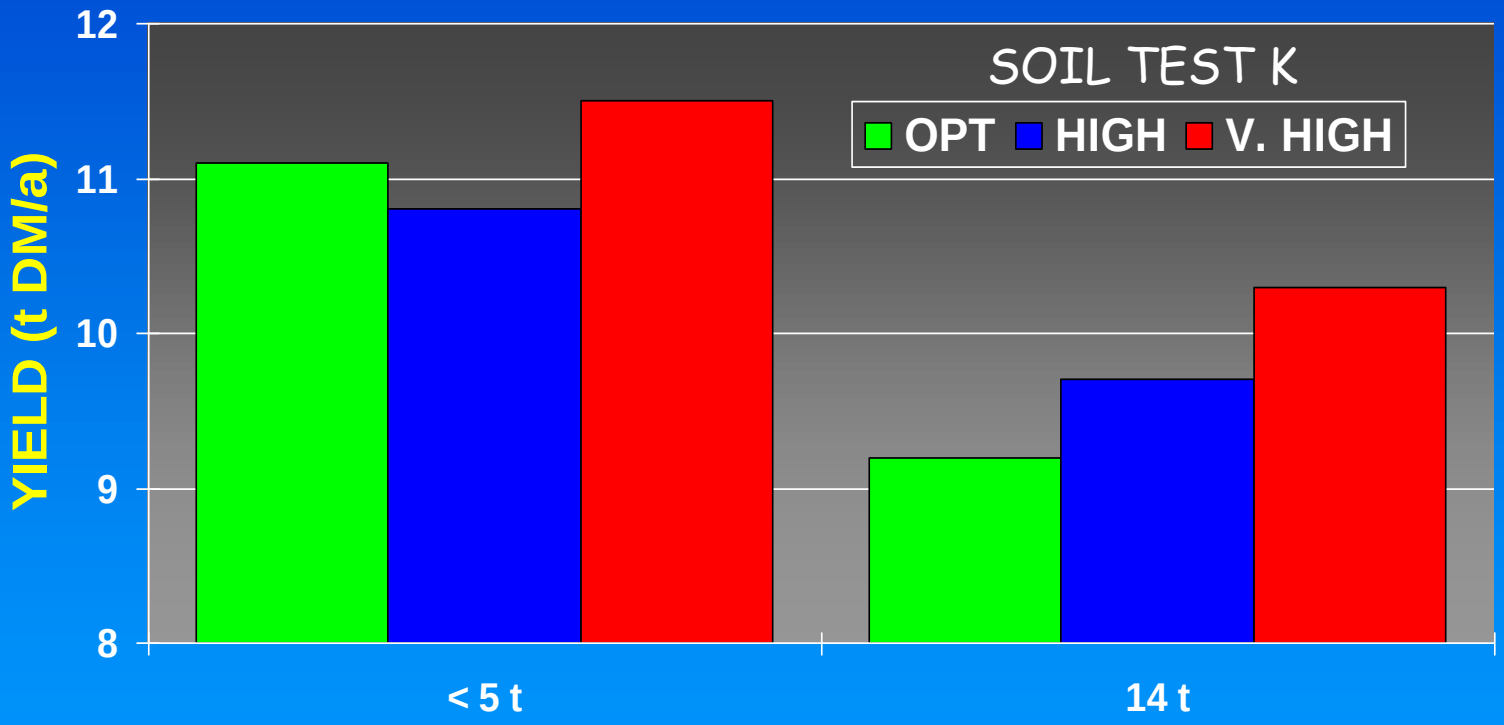

Wheel traffic compaction is a problem in forage production

EFFECT OF COMPACTION ON SOIL BULK DENSITY OF A SILT LOAM SOIL

DEPTH	COMPACTION	1991	1992	1993
in		--------	g/cc	--------
0-6	NONE	1.19	1.30	1.32
	14 †	1.36	1.41	1.40
6-12	NONE	1.31	1.33	1.31
	14 †	1.59	1.50	1.52
12-18	NONE	1.19	1.35	1.33
	14 †	1.45	1.44	1.33
18-24	NONE	1.36	1.35	1.34
	14 †	1.40	1.34	1.33

Compacted April 1991 and seeded to alfalfa

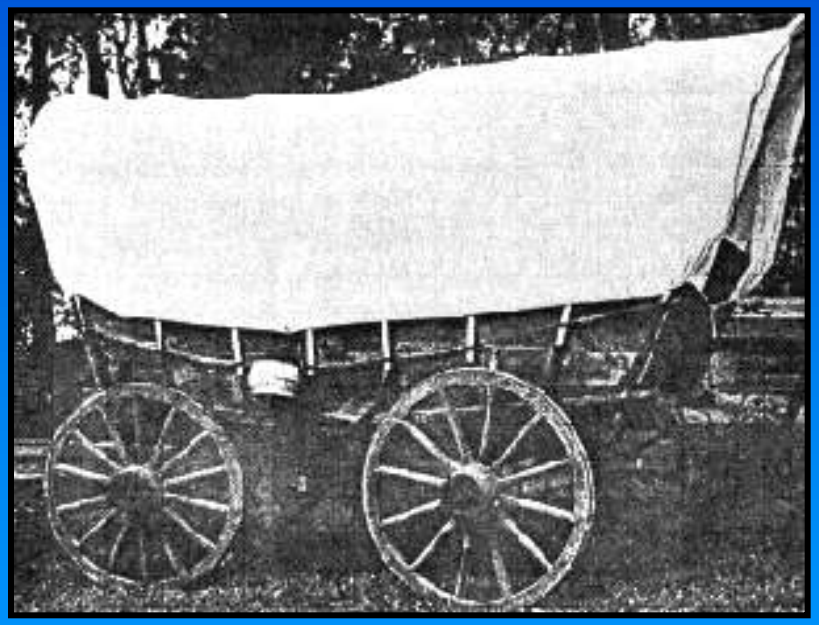
K SOIL TEST AND ALFALFA YIELD ON A COMPACTED SOIL (sum of 3 yrs.)

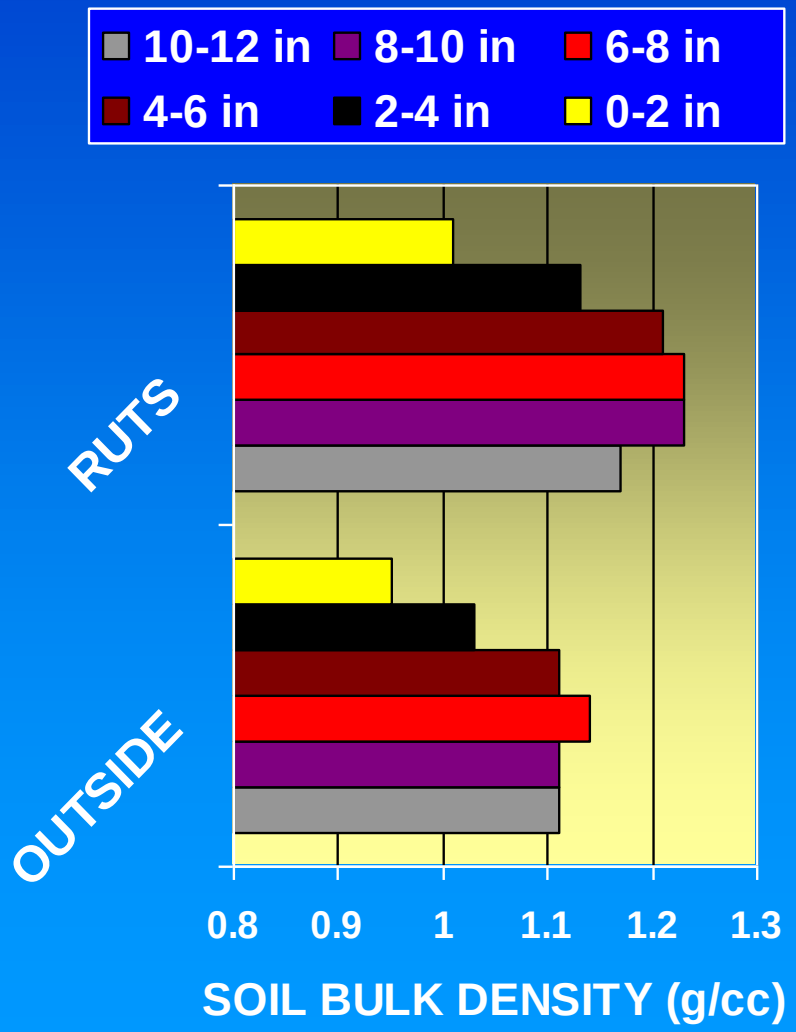


Arlington, Wis., 1994

DON'T COUNT ON MOTHER NATURE TO CORRECT COMPACTION

WADSWORTH TRAIL, MINNESOTA

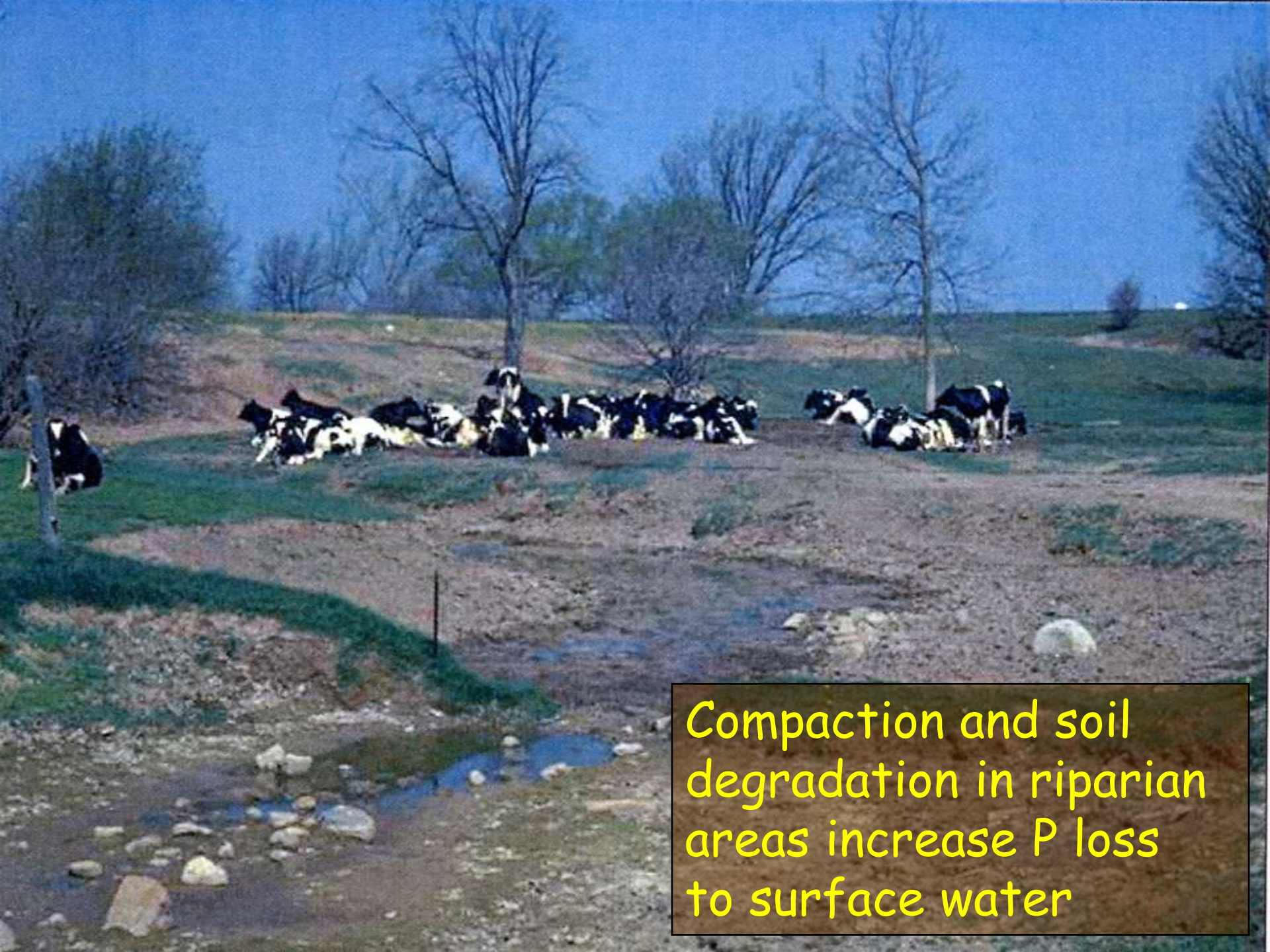




Sharratt et al., 1998

WHAT FACTORS AFFECT SOIL COMPACTION IN PASTURES

- ANIMAL TYPE
- STOCKING RATE
- SOIL TYPE
- SOIL MOISTURE AND DRAINAGE
- TRAFFIC PATTERNS
- FORAGE TYPE
- AREAS OF CONCENTRATION
- PLANT DAMAGE


Compaction and soil degradation in riparian areas increase P loss to surface water

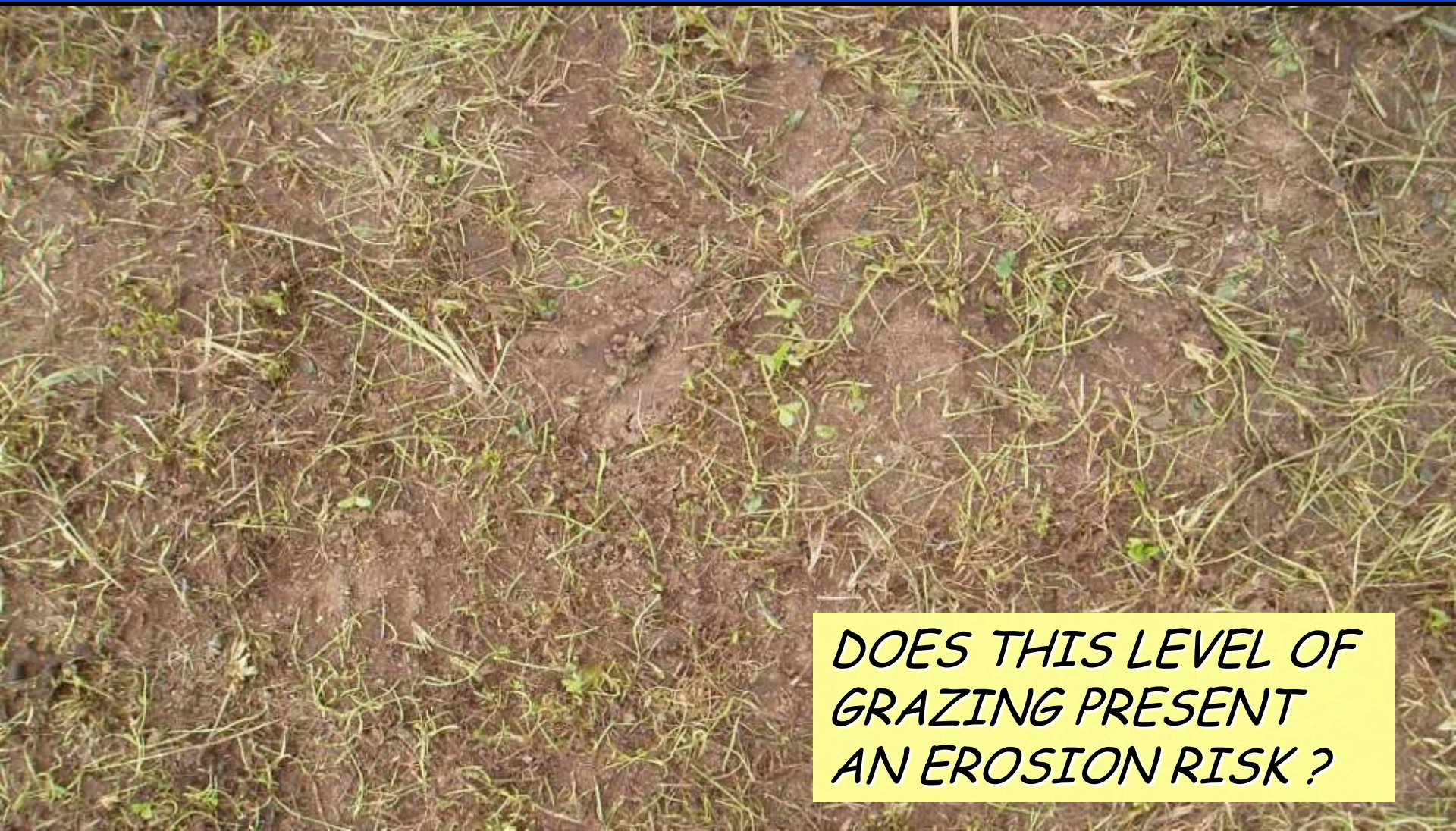
MALWEG PASTURE STUDY - 2004

- FIVE SITES (SO FAR)
- GPS GRID CREATED OVER FIELD
  - APPROX. 20 SAMPLE POINTS PER FIELD
  - SOIL SAMPLE 0-1, 1-6 in.
  - BULK DENSITY
  - PENETROMETER RESISTANCE

EXAMPLE DATA FROM A DANE COUNTY FARM

- PASTURE FOR THE PAST 10 YEARS
- SOUTH AND NORTH PASTURES
- NORTH NOT GRAZED PRIOR TO SAMPLING
  - WAS CUT FOR HAY IN JULY
- NORTH SAMPLED IN SEPTEMBER
  - WEST 1/3 WAS GRAZED THE DAY BEFORE
  - 6 HOURS, 80 HOLSTEIN COWS
- SOUTH ALSO SAMPLED AT THIS TIME

CLOSE-UP VIEW OF AN ORCHARD GRASS PASTURE FOLLOWING 6 HR. GRAZING BY 80 HOLSTEIN COWS



SOIL TEST LEVELS IN TWO SOUTHERN WISCONSIN PASTURES

SITE	DEPTH	pH	O.M.	P	K
	in.		%	------ ppm ------	
NORTH	0-1	6.2	5.8	47	156
	1-6	6.5	3.0	14	82
SOUTH	0-1	5.7	6.8	45	146
	1-6	6.2	3.6	19	64

FIELD AVERAGE BULK DENSITY, POROSITY, AND WATER CONTENT

DEPTH	BULK DENSITY	POROSITY	WATER CONTENT
in.	g/cc	---------- % ----------	
0-4	1.27	52	35
4-8	1.34	50	33

South pasture

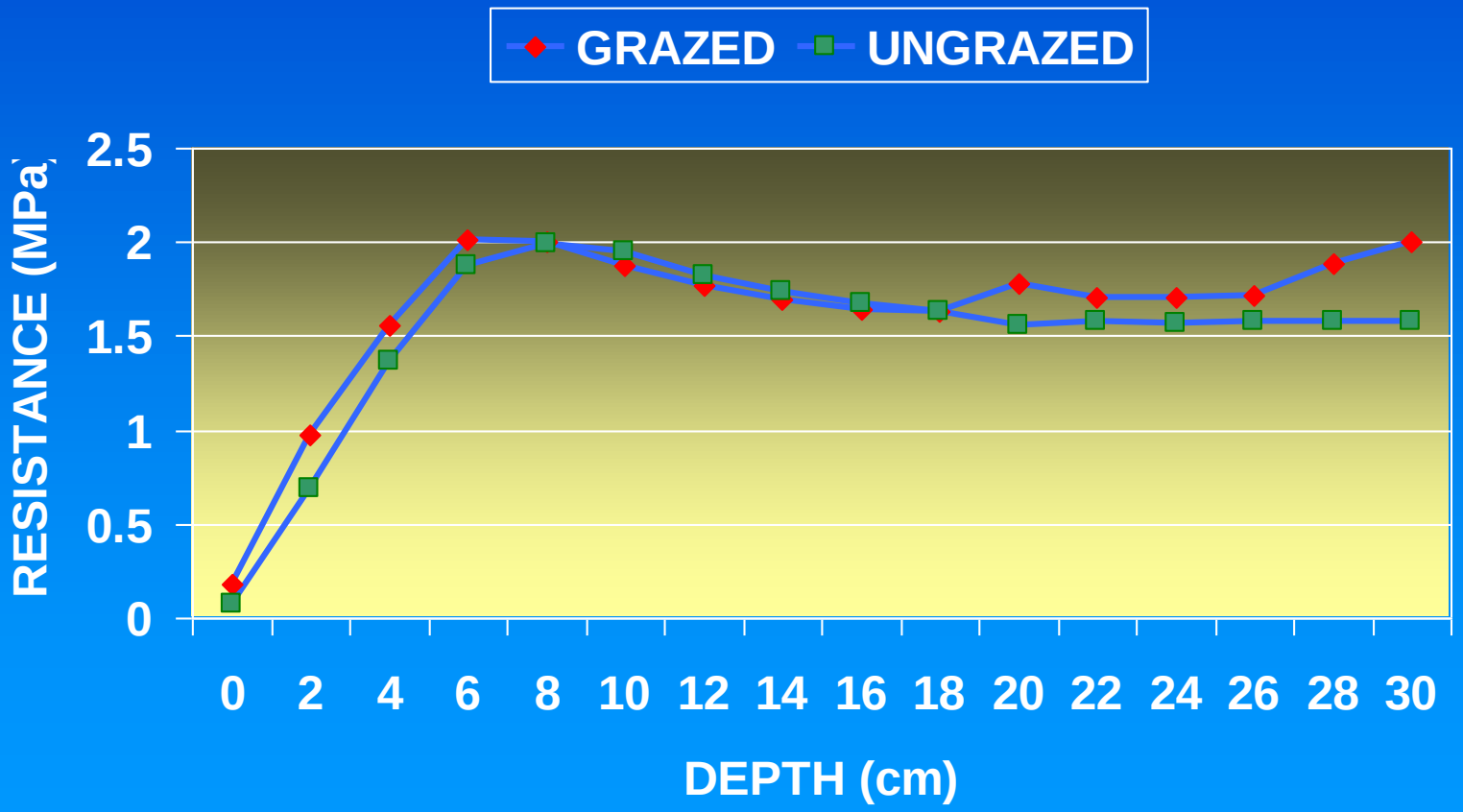
COMPARISON OF GRAZED vs. UNGRAZED CONDITION

UNGRAZED

North pasture

GRAZED

PENETROMETER RESISTANCE FOLLOWING 6 HOURS OF GRAZING BY 80 HOLSTEIN COWS



PENETROMETER RESISTANCE (MPa) AT 4 cm AS AFFECTED BY GRAZING

UNGRAZED		GRAZED	
2.15	1.66	1.76	1.77
1.23	1.33	1.96	1.42
1.16	1.24	1.43	1.20
0.81	1.37	1.40	1.50

North pasture (each value is the mean of three probes)

PENETROMETER RESISTANCE (MPa) AT 8 cm AS AFFECTED BY GRAZING

UNGRAZED		GRAZED	
2.98	1.90	2.54	2.88
1.34	2.09	1.78	1.69
1.85	1.30	1.69	1.55
2.03	2.45	1.90	1.95

North pasture (each value is the mean of three probes)

GUIDELINES FOR MANAGING SOIL COMPACTION IN PASTURES

- Minimize Stocking Time on Wet Soils
- Evaluate and Monitor Crops and Soil
- Soil Test to Assure Adequate Fertility
- Use a Reasonable Rotation Scheme
- Control Heavy Vehicle Traffic
- Address Compaction Issues When They Occur


I'VE GOT PLENTY OF COMMON SENSE!
I JUST CHOOSE TO IGNORE IT.
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